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JUL 80 E R HUGET, S G VERMILYEA, M J KUFFLER

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The obvious and important advantage of low cost offered by the test base metal alloys is countered by their inadequate casting accuracy. Until this problem can be overcome, the acceptance of such alloys for routine use in military dental practice is not warranted.

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ACCURACY OF SMALL BASE METAL DENTAL CASTINGS

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Commercial materials and equipment are identified in this report to specify the experimental procedure. Such identification does not imply official recommendation or endorsement or that the equipment and materials are necessarily the best available for the purpose.

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Dental Laboratory Technician

ACCURACY OF SMALL BASE METAL DENTAL CASTINGS

Over the past ten years, USAIDR in-house effort has remained abreast with the industrial development and marketing of numerous "alternatives" to conventional dental golds. Determination and evaluation of composition, structure, physical and chemical properties, biologic features and manipulative characteristics of a broad spectrum of base metal crown-and-bridge alloys have played a prominent role in our search for cost effective replacements for expensive casting golds.

This report is based on observations of the apparent quality of fit of base metal dental restorations fabricated by current state-of-the-art techniques.

Materials and Methods

A durable counter-replica of the anatomic crown of a freshly extracted maxillary right first molar was made from an industrial grade silicone.* Then the tooth was machined to receive a full crown cast restoration. The tapered (~6°) walls of the preparation were finished with a fine grit diamond rotary instrument and polished with an aqueous slurry of flour of pumice. The tooth's circumferential, chamfered cervical margin was refined with the use of sharp hand instruments.

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* RTV-77, General Electric, Waterford, NY 12188

Six counter-replicas of the molar preparation were made from the aforementioned polymeric material. Ultimately, each of these molds was used to produce 64 stone[+] replicas (dies) of the prepared tooth. Full crown wax patterns exhibiting reasonable consistency with respect to size and anatomic form were constructed on the test dies in the following manner. The mold (counter-replica) of the unaltered tooth was filled with molten inlay wax. Each die was inserted into the mold and stabilized until solidification of the wax occurred. After withdrawal of the die-wax couple from the mold, the cervical margin of the pattern was refined and trimmed to the margin of the die with a heated hand carver. Integrity of the die-wax phase boundary was confirmed with the use of a stereoscopic microscope.

A preformed wax sprue with reservoir was attached to the tip of the distal buccal cusp of each pattern. Each pattern-sprue assembly and a blind vent constructed from a cylindrical wax-piece were luted to a spue former. A proprietary surface tension depressor[#] was applied to the internal and external surfaces of each wax crown. Excess amounts of this agent were removed from the sprued patterns prior to their investment with the use of a soft and dry artist's brush.

+ Artificial Dental Stone, Whip-Mix Corp., Louisville, KY 40217.

Debubblizer, Kerr Manufacturing Co., Romulus, MI 48174

The investment procedure was tailored to allow assessment of the influence of investment material[§] and laboratory technique on the fit of dental restorations cast from four base metal alloys.[¶] Design of the regimen made possible the comparative evaluation of (1) the accuracy of small castings made with and without the use of asbestos-lined steel rings, (2) the effects induced by dilution of the investment materials' liquid components and (3) the accuracy of castings made by hygroscopic and thermal techniques. Accordingly, 192 refractory molds were made from each investment material. The patterns allotted for use with each investment material were apportioned as shown in Figure 1.

Conventional, nonremovable steel rings (1.5 in X 1.5 in) with single thickness asbestos liners were used in production of one-half of the total number of refractory molds. Removable cylindrical matricies made of dental base plate wax were used to produce 1.5 in X 1.5 in-ringless molds. The powder and liquid (silica sol concentrate or equal volumes of concentrate and water) components of each investment material were proportioned, mixed and poured as prescribed by the manufacturer.

Compensatory setting expansion of the freshly poured investments was achieved either by allowing the molds to bench-cure or to cure while immersed in 100°F-water.

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§ Ceramigold, Whip-Mix Corp., Louisville, KY 40217 and Complete, J. F. Jelenko and Co., New Rochelle, NY 10801.

¶ Ceramalloy, Johnson & Johnson, East Windsor, NY 08520; Ticon, Ticonium Co., Inc., Albany, NY 12207; Microbond NP-2, Howmedica, Inc., Chicago, IL 60632 and Victory, Unitek Corp., Monrovia, CA 91016.

Upon curing, the molds were placed in a cold furnace, heated slowly to 1,350°F and held at temperature for one hour to insure complete wax elimination. The test alloys were melted and cast with the use of an automatic induction casting machine.[Ω] The castings were retrieved from bench-cooled molds and sandblasted for removal of residual investment and oxide films. Then the castings were replaced on their respective dies, examined with the aid of a stereoscopic microscope and scored as adequate, oversize or undersize.

Results

The findings are presented in Figures 2-5. Overall, fit of the test castings was poor. Scores for the total specimen population were distributed as follows: Adequate 10%; undersize 64% and oversize 26%. Categorially, the ratios of undersize to oversize castings were 1:1 and 12:1 for Complete and Ceramigold investments, respectively.

Ceramalloy and Ticon were the only alloys from which adequate restorations were cast. Castings of NP-2 and Victory from Complete molds were consistently undersize. However, castings of all test alloys produced in ringless, hygroscopically expanded Ceramigold (powder and undiluted liquid) molds were oversize.

Ω Electromatic Casting Machine, Howmedica, Inc., Chicago, IL 60632.

Discussion

The data may be indicative of the sensitivity of base metal crown-and-bridge alloys to conventional dental laboratory procedures. However, the tendency for the employed procedures to yield a proponderance of undersize and oversize castings is attributed mainly to alloy-investment interaction. This premise is supported by the disparate ratios of undersize to oversize castings emanating from molds of the two investment materials.

The potential for improvement of the fit of small base metal dental restorations may be enhanced by further modification of the Ceramigold-ringless mold fabrication technique. However, the extent to which manipulative variables (spatulation, powder-liquid-water portions and curing environment) influence compensatory expansion of Ceramigold molds is uncertain. Presently, these factors limit the range of application of the four test alloys in military dental practice.

Summary

The obvious and important advantage of low cost offered by the test base metal alloys is countered by their inadequate casting accuracy. Until this problem can be overcome, the acceptance of such alloys for routine use in military dental practice is not warranted.

Legends for Figures

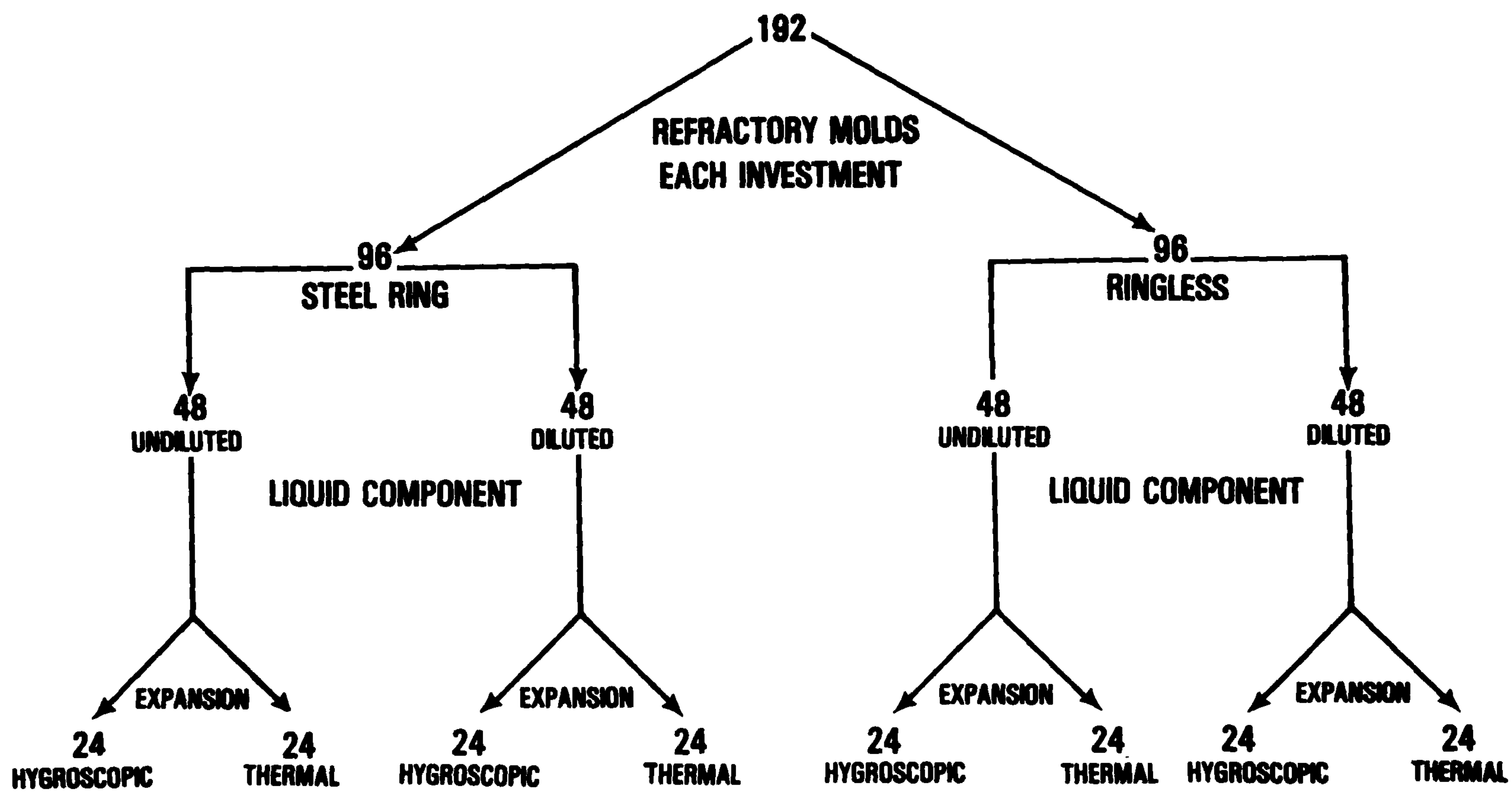
Figure 1. Apportionment of refractory molds for the fabrication of test base metal castings.

Figure 2. Distribution of Ceramalloy castings with respect to apparent fit.

Figure 3. Distribution of Ticon castings with respect to apparent fit.

Figure 4. Distribution of Microbond NP-2 castings with respect to apparent fit.

Figure 5. Distribution of Victory castings with respect to apparent fit.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REFRACTORY MOLDS
EACH INVESTMENT
96
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96
RINGLESS
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UNDILUTED
48
DILUTED
LIQUID COMPONENT
48
UNDILUTED
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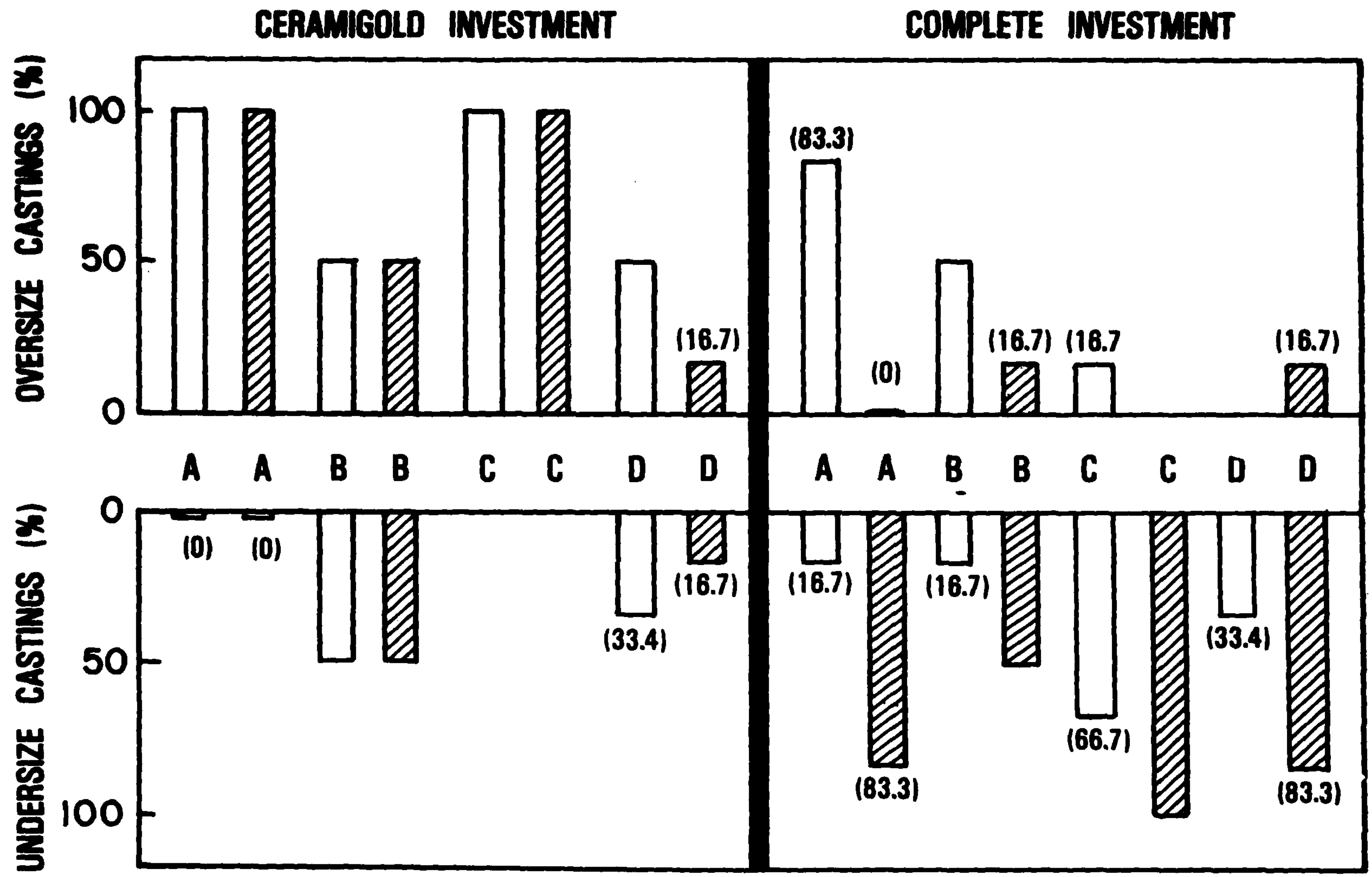
CERAMIGOLD INVESTMENT
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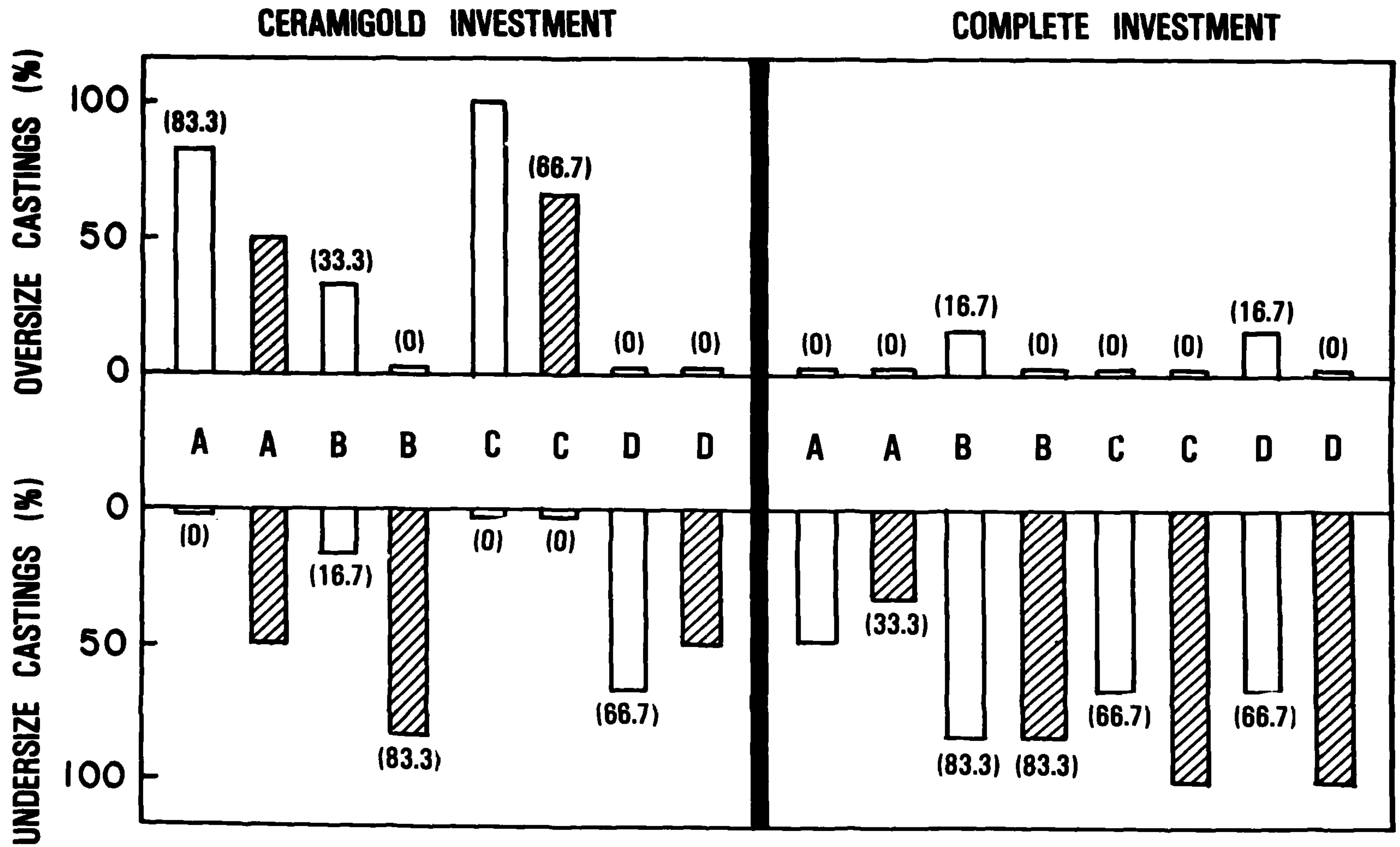

CERAMIGOLD INVESTMENT
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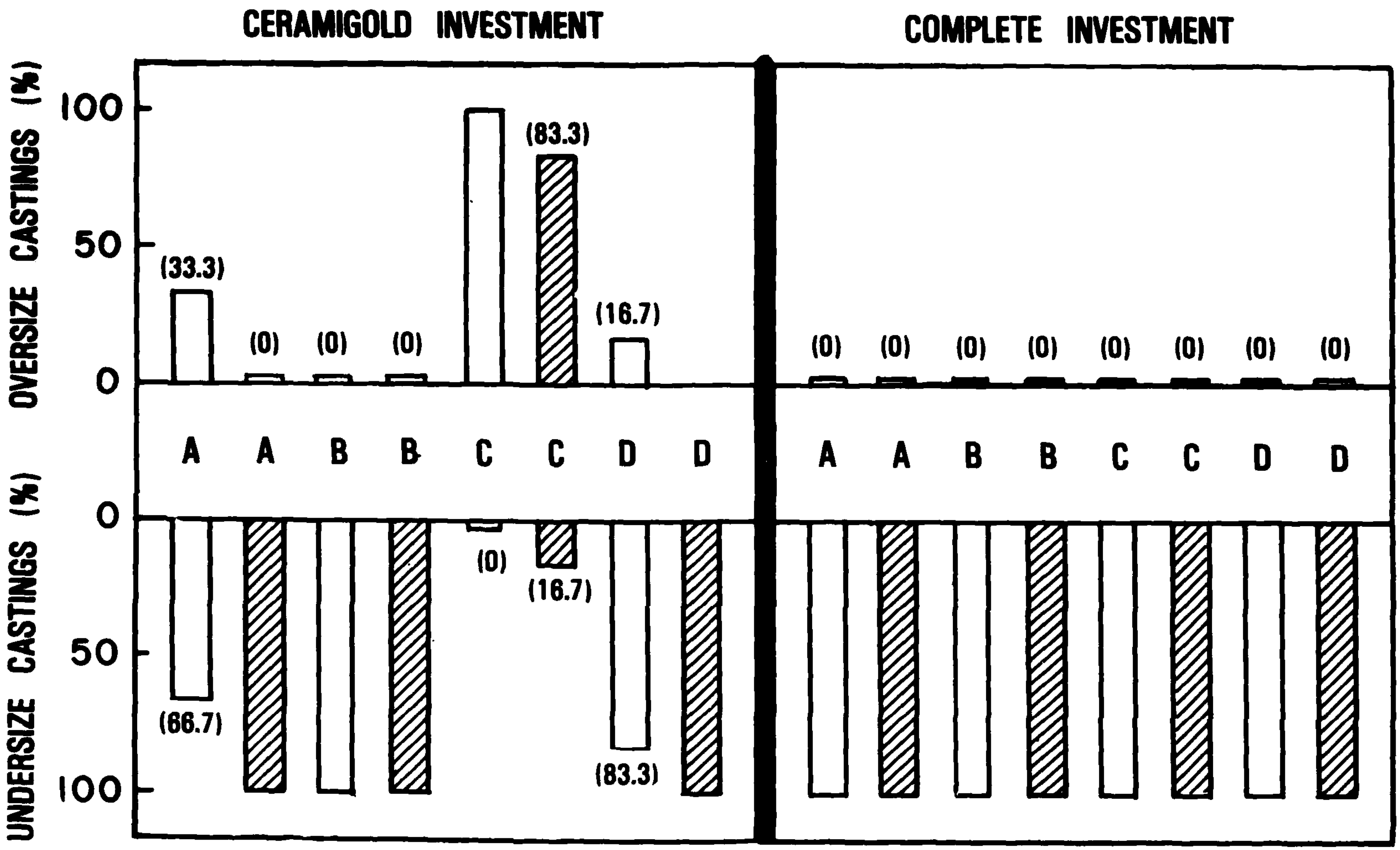
CERAMIGOLD INVESTMENT
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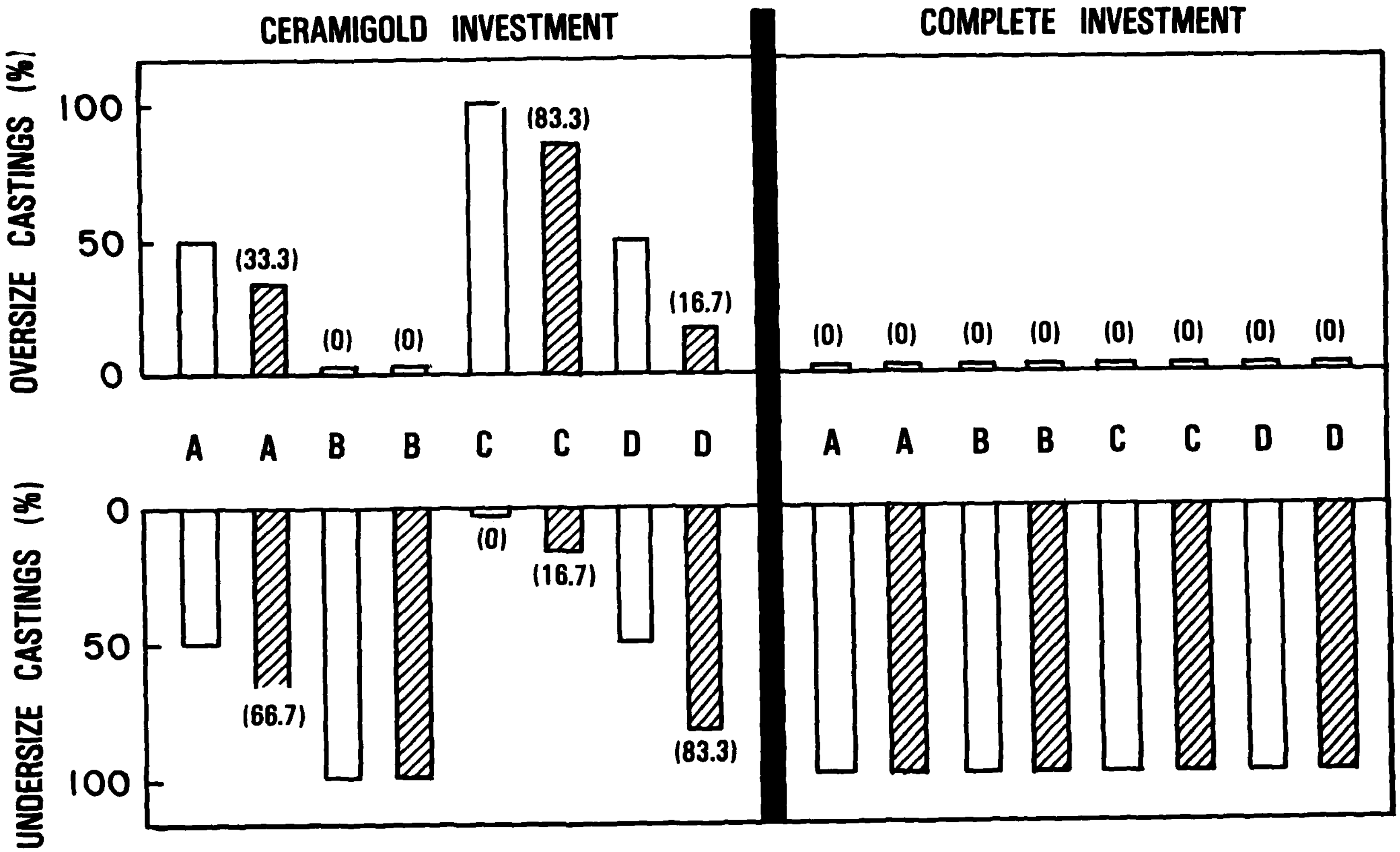
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